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An Appraisal of the Desert Locust Problem

O. B. LEAN

Plant Production Branch, Agriculture Division, FAO, Rome

THE increased knowledge of the desert locust (*Schistocerca gregaria* Forsk.) acquired during recent years has necessitated a re-appraisal of the plague dynamics of this locust species. Evidence obtained from the critical analysis of records of the movements of swarms and scattered locust populations and of the seasonal occurrence and geographical distribution of breeding, indicated that the problem of desert locust plague prevention was substantially different from that of some other locust species which have been brought under control in their outbreak areas. Greatly intensified laboratory and field research has also elucidated many features of the complex locust behavior and led to a fuller understanding of the problem. The development of a preventative policy of desert locust control has long been recognized as the ultimate objective, but insufficient knowledge of the fundamental features of the species' plague dynamics has delayed the formulation of any practical plan.

Plague prevention was discussed by the FAO Technical Advisory Committee on Desert Locust Control at its Fifth Session in August 1955. The Committee concluded that a carefully prepared and comprehensive plan of investigations was essential before any long-term control policy could be considered, and it recommended that the Director-General of FAO should appoint a small panel of experts for this purpose. The following were accordingly invited by FAO to serve on the Panel in their individual capacities as desert locust experts:

C. I. H. Aspliden, World Meteorological Organization;
A. Davatchi, Iran;
M. Afzal Husain, Pakistan;
Mohamed Hussein, League of Arab States;
R. J. V. Joyce, Sudan;
E. Morales Agacino, Spain;
Y. Ramchandra Rao, India;
C. Rungs, Morocco;
B. P. Uvarov (Chairman), Anti-Locust Research Centre, London.

The Panel met in London, 9-20 April 1956. Much of the research on the desert locust has been undertaken or stimulated by the Anti-Locust Research Centre and it was therefore appropriate that the discussions should be held at the Centre and under the chairmanship of its Director.

The present article aims at providing a summary of the modern conception of the dynamics of desert locust plagues, as developed, by the Expert Panel.

Distribution of the Desert Locust

Within the total distribution region within which the species occurs, the desert locust invasion region, subject to invasion by swarms, extends from Assam to the Ca-

nary Islands and from the southern Soviet Republics and Turkey to Tanganyika, covering about 64 territories. This immense area must be treated as a single entity interconnected by displacements of swarms over distances of 1,000 to 3,000 kilometers between successive breeding areas. Swarms produced at one end of the region might, within two generations, have a decisive influence on the progress of a plague at the other end. Amongst well documented instances of long-range displacements, there was the example of swarms escaping from breeding areas in Ethiopia and the Somalilands in late 1951 covering a distance of 3,200 kilometers to Iraq in four weeks. Some of these swarms subsequently reached Afghanistan and Pakistan. It had also been established that swarms rarely bred within 1,000 kilometers of their place of origin.

The breeding region, though extensive, is more restricted than the invasion region. Successful breeding was possible only under a relatively narrow range of ecological conditions, and within the invasion region breeding occurred according to season along two main belts: (*a*) the belt of breeding on spring rains which runs through northwestern and northern Africa, the Near East, Iran and Pakistan, and (*b*) the belt of breeding on summer rains which extends from Senegal across Africa to the Red Sea and through southern Arabia to Pakistan and India.

Displacement of Swarms

During their displacement locust swarms frequently maintain their identity and coherence for considerable periods and over long distances. Powerful behavior reactions prevent swarms being dispersed by air turbulence such as would affect passive but otherwise comparable airborne aggregations. Hopper bands also strongly resist dispersal by environmental factors.

The direction of the displacement of a swarm as a whole, irrespective of the random orientation of the component individual flying locusts, was consistently in very close agreement with the direction of the mean wind between the ground and the level of the topmost locusts.

As a result, coherent swarms, moving directly down wind, eventually reach zones of convergent wind flow. Convergent wind flow was also an essential factor in the production of widespread heavy rain. Areas of swarm convergence therefore tend to coincide with areas receiving the rainfall which permits the flush of vegetation required as food for the hoppers of the following generation.

Displacement of Solitary Locusts

Knowledge of the distribution of solitary desert locusts is very incomplete, but it is known that solitary locusts and scattered populations occur in many localities. As these localities are typically characterized by sparse and seasonal vegetation, mobility of individual locusts at some stage in their life cycle was essential to maintain the continued existence of scattered populations. The mobility of solitaries has indeed been demonstrated and it has also been shown that their displacements take place down wind and follow the same seasonal pattern as that of swarms. As, however, solitary locusts are mainly nocturnal fliers they are likely to be more restricted in their movements than day flying swarms, and differences between the movements of solitary locusts and swarms are also likely to result from differences between night and day weather conditions, particularly winds.

The mechanism which results in the concentration of initially widely scattered locusts into limited areas where rain has fallen might operate on a large scale over thousands of kilometers and locally within distances of tens of kilometers, and they could also be expected to operate, though with varying degree, during the day or night.

Within the concentration areas stocked with locusts by this mechanism, other factors, insufficiently studied, would have to operate to complete the formation of coherent swarms leading to gregarious breeding.

Breeding Frequency

The detailed analysis undertaken by the Anti-Locust Research Centre of the frequencies of desert locust swarm occurrence and breeding in every 1° latitude × longitude square of the invasion region provided a means of estimating on both a geographical,

territorial and seasonal basis the relative threat to any area and the relative importance of different areas for the continuity of a plague.

These studies showed that areas of high frequency breeding were relatively restricted and occurred in India, Pakistan and Iran, on the Arabian and Somali Peninsulas, in Ethiopia, the Sudan, Morocco and Algeria. The infestations are seasonal over most of the distribution area and even at the height of a plague the most frequently infested areas might be free of swarms and hoppers for seasons or years. Elsewhere there might be two or three breeding seasons in a year. Similarly, during plague years, all locust swarm activity may become restricted to relatively small seasonal regression areas from which the plague may again spread within a few months over much of the invasion region.

Fluctuations in Plague Activity

One of the most significant results of the study of past records is the conclusion that, while there were marked annual fluctuations in the numbers of infested territories, some swarms were present somewhere within the invasion region in every year. There were, therefore, no intervals completely free of swarms between plagues, only recession periods of a year or more without widespread and intense swarm activity or seasonal regression periods of short duration.

Development of Plagues

From its review of the known fundamental features of the desert locust problem as they affect long-term control, the Panel concluded that the previous conception of desert locust plagues developing within a few static outbreak areas had become untenable.

With such locusts as the African migratory locust (*Locusta migratoria migratorioides*) and the red locust (*Nomadacris septemfasciata*), there had been long intervals of years when the whole invasion region was free of swarms, the species persisting only in the solitary phase. Plagues of these locusts arose from gregarization within localized static outbreak areas.

Plagues of the desert locust, on the other hand, might arise from the carry-over of some swarms during recession periods or from the concentration of scattered locusts, as a result of meteorological factors, into areas suitable for gregarization. The resurgence of desert locust plagues might therefore be expected to be initiated in diverse areas, determined by the weather systems operating at the time, somewhere within the total breeding region, especially in high frequency breeding areas.

Conclusions

The above general conclusion is not entirely new and has been foreshadowed for some time, but the Expert Panel has produced an authoritative and stimulating review of the desert locust problem as it is seen today, and which establishes a scientific basis for future work.

Following its review of the problem, the Panel recorded its opinion that no immediate scheme of preventative control of the desert locust could be recommended. The need for intensified research and survey to fill the many gaps in existing knowledge was stressed, and a plan of such investigations was prepared. Together with the Panel's technical review, this plan will be submitted to the next session of the FAO Technical Advisory Committee on Desert Locust Control for review and recommendations.

Cacao Diseases in Haiti

R. G. ORELLANA
Inter-American Institute of Agricultural Sciences, Turrialba, Costa Rica

In connection with the effort of establishing a program for the expansion of cacao industry in Haiti, the writer, at the invitation of the *Institut Haïtien de Crédit Agricole et Industriel*, carried out a reconnaissance of cacao diseases present in the growing areas from 14 to 28 January 1956.

Haiti is enclosed on the west coast by two peninsulas. Cacao is mainly grown in the southern peninsular area. In the northern peninsular area, cacao is not as extensively grown as in the south and the terrain is less mountainous. On the steep hills, however, cacao is generally planted, and in some cases interplanted with coffee.

Most of the cacao trees grown in Haiti belong to the Forastero-Trinitario complex. Occasionally types approaching the Angoleta, Ecuadorian "Nacional" and Calabacillo were observed. In general the tree populations appear rather uniform.

Many of the common diseases of cacao were observed during the visit, among which the pod rot caused by *Phytophthora* was the most widespread and destructive disease responsible for heavy losses throughout the country. On the other hand, there were no clear cases of virus diseases found.

Diseases in Southern Peninsular Area

Phytophthora rot. The *Phytophthora* disease caused by *P. palmivora* occurs in most of the cacao plantings visited and was found to be responsible for the rotting of mature and immature pods, dieback of chupons and a minor amount of leaf blight. The prevalence of the pod rot phase of the disease is apparently the most important cause of losses, although the other two types of infection undoubtedly play an important role in the dissemination of the fungus as well.

As in the case of *Phytophthora* diseases of many other crops, the *Phytophthora* rot of cacao was found to be most prevalent in regions with heavy and prolonged rainfall and low night temperature. Most of the fully developed cacao pods attacked by rots carried infection, a factor which facilitates the maintaining of an inoculum potential worthy of attention.

Within the rather uniform population of cacao trees in Haiti, no great differences in the susceptibility to the *Phytophthora* disease was observed. However, it would be possible to discover field resistance by keeping records of individual trees which have been reported by growers to be resistant. Such trees would provide material for future selection and breeding.

No trunk canker was observed in the plantings examined, possibly because of the apparent absence of the true Criollo strain. As observed in Colombia and Venezuela, the Criollo type is very susceptible to the tree canker type of the *Phytophthora* infection.

Losses due to *Phytophthora* are likely to occur even when spraying with fungicides and sanitary measures including frequent harvest, pruning and light shading are practiced. Consequently spraying of old plantings would probably be uneconomical. New plantings, however, should be treated periodically with fungicides. Bordeaux mixture has been proved to be the most effective fungicide in many countries for the control of this disease, but the inconveniences of its preparation often limits its wide use. The commercial preparations of cuprous oxide or zineb are equally effective and more convenient in application. Addition of commercial urea appears to increase the yield, as shown by experiments carried out at the Cacao Experimental Farm of the Inter-American Institute of Agricultural Sciences.

Cherelle wilt. At the time of the visit two types of wilted cherelles were seen in most of the bearing trees. The main one which might be caused by nutritional factors was characterized by a yellowing of fruits up to

8 centimeters in length. The affected pods later turned black and hard. Another was caused by *Phytophthora* infection in which the cherelles showed an advancing brown discoloration, turning eventually into total blackening. The texture of the cherelles wilted by the fungus is soft, a character which allows field distinction of the two conditions.

Brooming disease. The writer observed in Jamaica in 1954 a brooming effect called "false witches' broom" both in old, dilapidated cacao trees and in cola trees (*Cola nitida*) in the same area. Sporophores developing on old, detached pods were creamy in color. A sample of those pods sent to Kew, England, had been identified as belonging to the genus *Mycena*. This disease is at present considered of little or no economical importance in Jamaica.

A similar brooming effect was found on cacao trees in Haiti at two locations, Baliverne and La Vallette. As in Jamaica most of the trees affected appeared to be very old and in a stage of abandonment. At La Vallette, a hilly, humid area about 10 kilometers inland straight from Chambellan, the disease was rather prevalent. At Baliverne, a hilly area closer to the sea, the disease appeared to be less severe, although some young trees had brooms. The altitudes of the two areas were approximately the same, about 200 meters. A search for sporophores of *Mycena* on the trees, pods and on the remains of pruned branches laying on the ground failed but sporophore development was later observed on specimens kept in moisture chamber by Mr. F. Pierre-Louis of the Haitien Department of Agiculture at Damien.

The *Mycena* fungus is a relative of *Marasmius perniciosus*, the cause of witches' broom prevalent only in northern South America. However, the brooming disease observed in Haiti was not as extensive or destructive as the *Marasmius* disease. As it affects mainly senile and unkept trees, the brooming disease is unlikely to become a handicap in cacao cultivation.

A doubtful case of brooming was observed at Sule and Morne Mulet. The anatomy of the brooms appeared somewhat different. In those particular instances the abnormal growth occurred on trees severely pruned, and it was not widespread.

Chlorosis and dieback. Most of the cacao trees on level land and slopes directly exposed to the sea had pale green or intensely yellow leaves. Dieback was also a conspicuous feature in those areas and physiological cherelle wilt was also observed. It was noted that those areas were densely shaded up to the time of the occurrence of the Hazel hurricane in 1954. Some of the shaded trees had died due to senility

Those physiological disorders can probably be corrected by adequate plantation management, such as proper fertilization and regulation of shading. Where dieback in associated with severe defoliation caused by fungi, the application of fungicides should be beneficial.

Figure 1. Marginal necrosis in a fully developed cacao leaf, commonly found in cacao plantings near the sea in Haiti.

Other physiological disorders. In addition to the chlorosis and dieback, two other disorders of physiological origin were observed. One which is characterized by a marked marginal necrosis on leaves of various sizes (Figure 1) was common and the symptom resembles closely that of potassium deficiency. The other is characterized by the sickle-shaped leaves with a conspicuous interveinal chlorosis (Figure 2), but the veins remain dark green. A similar disorder was seen on cacao in the Rivas area in Nicaragua. The sickle-leaf condition is probably caused by zinc deficiency and the interveinal chlorosis by manganese deficiency. However, it is likely that other factors may be involved in the symptom expression observed in Haiti.

Leaves showing reddish-brown patches were also repeatedly observed. This condition, however, appears to be the effect of burning by fires built by laborers.

Thielaviopsis pod rot. This disease due to *Thielaviopsis* spp. causes brown, sunken lesions covered by white-creamy spores, particularly on overripe pods.

Anthracnose. The causal organism of the disease is *Colletotrichum gloeosporioides.* It attacks mature and immature pods as well as leaves of seedlings and established trees. It is also a factor in the complex condition known as dieback of cacao trees and " bare tip " of seedlings.

Diplodia disease. The causal fungus, *Diplodia theobromæ,* is considered to be a weak parasite, attacking branches and chupons of malnourished trees and pods wounded or previously rotted by *Phytophthora.*

Red rust. In a few instances, red rust patches caused by the algæ *Cephaleuros mycoidea* were observed on cacao tree trunks and dieback branches. This disease is reportedly connected with a low nutritional status of the tree in areas deprived of protection from intense solar radiation. A somewhat severe attack of red rust was observed at Quepos on the Pacific side of Costa Rica. In that case, the shade had been eliminated, and the trees had been defoliated by thrips.

Thread blight. Although only minor cases of thread blight (*Pellicularia* spp.) were observed in this survey, this disease might become prevalent during periods of prolonged precipitation on plantations densely shaded.

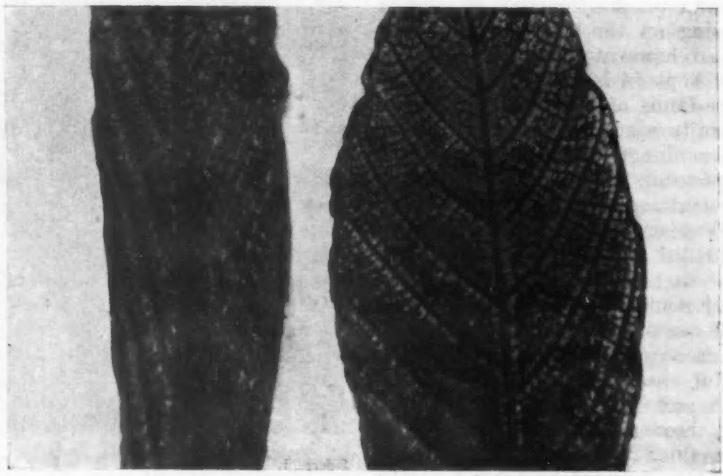

Figure 2. Sickle leaf with interveinal chlorosis of cacao in Haiti.

Ceratostomella canker. No cases which could be definitely linked with the infection of *Ceratostomella* spp. were observed in Haiti. The trees examined for the characteristic cankers on their limbs were too old for accurate identification. It is a sporadic disease and is likely to exist in that country. The initial symptom of the disease is the yellowing and reddening of the leaves which subsequently fall off. A healthy tree appears to die suddenly, hence the disease is sometimes called " morte subita " or as in Ecuador " machete disease " because the fungus penetrates through wounds.

Diseases in Northern Peninsular Area

The cacao disease conditions in the northern peninsular area of Haiti are similar to those in the south, except that *Phytophthora* disease appeared to be more widespread under dense shade and the brooming disease was not found.

The chlorosis-dieback symptoms of physiological origin were again seen in those plantings near the sea. Farther inland the trees were greener and in some places, as at Anse-à-Foleur (Meyance), a cacao plantation visited had apparently highly productive trees. Cacao plantings with little or no shade showed general dieback in the upper canopies of the trees but there were many pods on the trees in spite of the fact that the harvest peak had been passed long before.

Cherelle wilt, both physiological and induced by *Phytophthora*, was observed in many cases. The former condition was particularly common in plantings without shade.

Infections of *Thielaviopsis*, *Colletotrichum*, *Diplodia*, red rust and suspicious cases of *Ceratostomella* attack were found in this region as in the south.

Plant Disease Situation in the United States[1]

Paul R. MILLER
Plant Disease Epidemics and Identification Section
Agricultural Research Service, United States Department of Agriculture

Stalk Rots of Sorghum in Eastern New Mexico

HSI, C.H., of the New Mexico Agricultural Experiment Station, reports that stalk rots caused considerable damage to dryland and lightly-irrigated sorghum in eastern New Mexico in the summer of 1955. The stalk rots were prevalent in all major sorghum-growing sections, and affected grain sorghum, sweet sorgo, sudan grass, and broomcorn. The growing season was characterized by favorable soil moisture conditions at early stages of plant growth, followed by a rather long dry spell when the plants were maturing. This combination of environmental conditions was apparently conducive to the development of sorghum stalk rots.

Four types of stalk rots occurred, among which were anthracnose stalk rot and *Fusarium* stalk rot, not previously recognized in New Mexico.

Anthracnose stalk rot. Anthracnose stalk rot, caused mostly by *Colletotrichum graminicola* and partly by *Gloeosporium* spp., was prevalent on broomcorn and sudan grass. Although the disease was identified for the first time in 1955 its presence in New Mexico for years was reasonably certain. An outbreak was believed to have occurred in 1951.

In severely affected fields broomcorn plants ripened prematurely and frequently lodged under the pressure of moderate winds. The brush was often small and of very poor quality, and frequently dead before fully emerged. In extreme cases the entire field dried up, resulting virtually in a complete loss. External symptoms consisted of leaf anthracnose and discolored lesions on the outside of the basal stalks. Internal symptoms varied from complete discoloration and decay to partial decay of the basal portions of the stalks.

Fusarium stalk rot. *Fusarium* stalk rot, due to *F. moniliforme*, caused severe lodging in small areas of two sorghum fields, one dryland and the other irrigated. The causal fungus is present in the soil and invades the plants only through wounds. Symptoms are small heads with poor grain yield, root and stalk rot, and node lesions.

Charcoal rot. Charcoal rot, due to *Sclerotium bataticola*, did not become conspicuous until the plants were reaching maturity. Lodging was usually the first indication of the disease. In severe cases more than 30 percent of the plants broke over at the base. The affected plants showed under-developed heads with poor grain yield, premature ripening of stalks, and frequent discoloration on the outside of the basal stalks. Inside the stalks the pith was badly disintegrated, and the separated vascular bundles were covered with numerous minute sclerotia of the fungus.

In general, charcoal rot was more prevalent in sandy soil than in heavy soil. First, more sorghums are grown in sandy soil, hence the probability of finding this disease is greater. Second, sandy soil has less water-holding capacity and is more variable in temperature than either loamy soil or clay, and the combination of deficient soil moisture and high temperatures often favors the development of charcoal rot.

Indefinite stalk rot. Indefinite stalk rot associated with lodging was general. The point of breaking over occurred anywhere between the ground level and the base of the peduncle. Poorly developed heads and premature ripening usually accompanied lodg-

[1] This report in based upon material submitted by Collaborators of the Plant Disease Epidemics and Identification Section, Agricultural Research Service, United States Department of Agriculture.

ing. The interior of lodged stalks often showed water-soaked or discolored pith in varying degrees of disintegration. Bacteria, *Rhizoctonia solani*, *Fusarium*, *Helminthosporium*, *Alternaria*, and *Penicillium* were isolated from lodged stalks.

An Outbreak of Rice Blast in 1955

John G. Atkins, of the United States Agricultural Research Service, writes that in recent years the old rice disease caused by *Piricularia oryzæ* Cav., commonly known as blast, Piricularia, or rotten neck, had all but disappeared in the Gulf Coast rice area. Consequently, it has been considered as a very minor rice disease in those States. In 1955, however, it reappeared with sufficient severity to cause alarm, particularly in Acadia Parish in Louisiana. The fields affected were of the Magnolia or Zenit varieties.

The 1955 outbreak emphasizes the potential importance of this sporadic disease as well as certain of its interesting aspects. Blast was not observed on rice sown in April or May. It appeared in late July and early August on rice sown in June, and was confined to fields of young rice in the very susceptible mid-tillering stage. Most fields showed only light damage but a few suffered up to an estimated 20 percent defoliation, with nearly 100 percent defoliation in spots or areas within a field. Rotten neck symptoms were not observed except at Beaumont, Texas, on a few rather susceptible varieties and introductions.

The disease presumably became established and developed during July when the weather was hot, humid and rainy. Nightly dews along with numerous rains or showers, particularly light afternoon showers, and cloudy weather kept the rice leaves wet during most of the day and night. These conditions are nearly ideal for the production of conidia of the fungus and for development of the disease.

After a change in weather in August the disease stopped spreading and the new growth of diseased plants remained healthy or nearly so. It is probable that grain yields were not reduced appreciably except in some spots where stands were seriously damaged.

At the Rice-Pasture Experiment Station, Beaumont, Texas, blast was prevalent throughout a replicated variety-fertilizer test sown in June. Conspicuous differences in the amount of leaf infection were observed between fertilizer treatments and varieties. Plots receiving no nitrogen showed considerably less infection than plots with nitrogen. Potassium had no effect upon the amount of foliar infection. Rice is known to be more susceptible to blast in soils with high nitrogen content. Of the fields observed in Louisiana, blast was most severe in one that had been in pasture for perhaps 20 years. Blast has frequently been reported to be more serious on first-year rice land.

Observations in 1955 emphasized two noteworthy aspects of the disease: first, the necessity for favorable environmental conditions, and second, host susceptibility as related to age of plants and to nitrogen content of the soil. Whereas losses from some other foliage diseases of rice, such as white tip (*Aphelenchoides oryzæ*) and the leaf spots caused by *Cercospora oryzæ* and *Helminthosporium oryzæ* can be reduced by good cultural practices including fairly high nitrogen fertilization and long-term rotations, blast behaves in an apposite manner. In view of the potentialities of the blast disease shown during the 1955 outbreak, the importance of determining varietal reaction cannot be overlooked.

Nematode Parasites of Maize in North Carolina

R.R. Nelson reports results of a preliminary survey by the United States Agricultural Research Service and the North Carolina Agricultural Experiment Station on the coastal plain of North Carolina to determine the distribution and prevalence of nematodes parasitic to maize. Soil and root assays showed that high populations of one or more of five different parasitic nematodes were present throughout the region in " problem " fields where maize did not thrive. Meadow nematodes (*Pratylenchus* spp.) were most widespread, having been isolated from samples from all but three of the 40 counties included in the survey. The stubby root nematode (*Trichodorus* spp.) occurred in 24

counties and the tobacco stunt nematode (*Tylenchorhynchus claytoni*) in 22, scattered throughout the coastal plain with no apparent pattern of distribution. Root-knot nematodes (*Meloidogyne* spp.) and the sting nematode (*Belonolaimus gracilis*) were very much less prevalent, having been found in samples from only six and four counties, respectively.

Stunting indicating root injury attributable to nematodes in problem fields ranged from a few plants affected to as much as 80 percent observed in one small field.

The results of the survey indicate that nematodes are much more prevalent and more widely distributed on maize and may be causing considerably more damage to it than has been believed. Furthermore, the abundant population increases of certain nematodes on maize give it additional importance as a host to these organisms. The crop is commonly grown in rotation with high value cash crops, such as tobacco cotton, and peanuts, which are attacked by several of the nematodes also parasitic on maize.

Nematodes Associated with Maize Tobacco and Soybean in Maryland

In the spring of 1955 the Maryland Agricultural Experiment Station started a survey to determine the genera of known and possible plant-parasitic nematodes present within Maryland, and the distribution of these nematodes according to host, soil type, geographic area, and seasonal preference. Results of the first survey are reported by W.R. Jenkins, D. P. Taylor, and R. A. Bohde.

In 1955, collections were made primarily in the sandy-soil regions of the State, which include the lower eastern shore and the five tobacco-growing counties of southern Maryland. From May through September about 900 samples were taken from the basal portions of plants and included roots of the various hosts. Each sample was a composite of a single field. Collections were random, and were not restricted to fields showing symptoms of nematode injury.

Twenty-five genera of known or suspected plant-parasitic nematodes were found in the 328 samples collected, of which 143 were from maize, 111 from tobacco, and 74 from soybean. The percentage of samples in which each nematode genus occurred and the total frequencies and percentages are given in Table 1. The low figures for the genus *Meloidogyne* are said to be probably not truly representative, since no detailed search was made for galled roots.

Of the known plant parasites, *Tylenchorhynchus* sp. was most frequent in all samples and occurred in more than half of the maize and tobacco samples. *Pratylenchus* sp. was found in 45 percent and *Xiphinema* sp. in 41 percent of all samples. *Tylenchorhynchus claytoni* was frequent in tobacco samples and was often predominant in the nematode population. *Diphtherophora* sp., a possible plant parasite, was unusually frequent, having been found in 26 percent of all samples. Another suspected parasitic genus, *Dorylaimus*, occurred most frequently of all genera.

Besides the nematodes listed in Table 1, the common soil forms *Mononchus* spp. and *Rhabditis* spp. were found in 52 percent and 44 percent, respectively, of these samples.

Parasitic Nematodes Associated with Wild Strawberry in Maryland

To determine whether parasitic nematodes were present in newly cleared land where strawberry plants might be planted, A.C. Goheen and A.J. Braun of the United States Agricultural Research Service, sampled roots of wild strawberry plants (*Fragaria virginiana*) and adjacent soil from 12 wooded areas in Maryland, where the forests were at least 30 years old. The samples examined were restricted to the border regions of the woods because *F. virginiana* does not grow in dense shade. The roots of the wild plants in the samples showed varying degrees of root rot, similar to that found on plants in many commercial strawberry fields.

Parasitic nematodes were found in 10 of the 12 samples. The nematodes and the frequency of their occurrence were as follows: spiral nematode (*Helicotylenchus nannus*) in seven samples, dagger nematode (*Xiphinema* sp.) in five, ring nematode (*Criconemoides* sp.) in five, meadow nematode (*Pratylenchus penetrans*) in four, ring nematode (*Criconema* sp.) in three, northern root-knot nematode (*Meloidogyne hapla*) in one, stylet nematode (*Tylenchorhynchus* sp.) in one,

TABLE 1. *Plant-parasitic and possible plant-parasitic nematodes found in the soil about the roots of plants in 328 fields in southern Maryland, 1955.*

GENUS	Percentage of samples containing nematodes from fields of the indicated crop [a]			
	Maize	Tobacco	Soybean	All 3 crops
Aphelenchoides	14.0	19.8	16.2	16.5
Aphelenchus	39.2	25.2	37.9	34.1
Criconemoides	3.5	1.8	2.7	2.7
Diphtherophora	22.4	29.8	28.4	26.2
Discolaimus	14.0	15.3	14.9	14.6
Ditylenchus	57.3	45.9	47.3	51.2
Dorylaimellus	0.7	0	0	0.3
Dorylaimus	86.7	91.9	96.0	90.5
Doryllium	3.5	0.9	2.7	2.4
Helicotylenchus	26.6	12.6	29.7	22.6
Hemicycliophora	0.7	0	0	0.3
Hoplolaimus	17.5	15.3	23.0	18.0
Leptonchus	0	0.9	2.7	0.9
Longidorus	5.6	0	6.8	4.0
Meloidogyne	1.4	2.7	9.5	3.7
Neotylenchidæ [b]	4.2	17.1	10.8	10.1
Paratylenchus	8.4	11.7	2.7	8.2
Pratylenchus	65.8	17.1	47.3	45.1
Psilenchus	10.5	7.2	2.7	7.6
Rotylenchus	4.2	2.7	0	2.7
Trichodorus	7.7	4.5	13.5	7.9
Tylencholaimellus	7.0	1.8	5.4	4.9
Tylenchorhynchus	51.0	68.5	39.2	54.2
Tylenchus	25.1	29.8	35.2	29.0
Xiphinema	39.8	44.1	39.2	41.2

[a] Of the 328 samples from all three crops, 143 were from maize fields, 111 from tobacco fields, and 74 from soybean fields. Each sample was a composite of a single field.

[b] Included were the genera *Deladenus*, *Neotylenchus*, *Nothotylenchus* and *Paurodontus*.

lance nematode (*Hoplolaimus* sp.) in one and pin nematode (*Paratylenchus* sp.) in one. Three samples each from Anne Arundel, Montgomery, and Howard Counties and one from Carroll County contained at least one of the parasitic nematodes. One sample each from Carroll and Washington Counties were free of parasitic nematodes. One sample collected in Anne Arundel County contained meadow, northern root-knot, dagger, ring and stylet nematodes.

Spiral nematodes were encountered most frequently. In the soil from five of the samples, they were the most abundant nematode found. Dagger, ring, and stylet nematodes were each found in large numbers in soil in at least one of the samples. Meadow nematodes and northern root-knot nematodes were found as endoparasites in the wild strawberry roots, in four and in one of the samples, respectively.

These data indicate that many nematodes that can parasitize strawberry plants are widely distributed in wooded areas in Maryland. Because these woodland areas are located in regions where cultivated crops may have been grown a century or two earlier and because nematodes may have been carried by water or by animals from nearby cultivated land, it is not possible to state definitely that these nematodes are indigenous. However, since meadow, ring, dagger, and spiral nematodes were found in four to seven of the 12 wooded areas, circumstantial evidence suggests that these four nematodes at least are indigenous in Maryland.

Outbreaks and New Records

Israel

G. COHEN
Division of Plant Protection
Ministry of Agriculture, Jaffa

Incidence of Pests and Diseases, 1955

Citrus. The citrus rust mite (*Phyllocoptruta oleivora*) and black scale (*Chrysomphalus aonidum*) caused severe damage. Psorosis or scaly bark was restricted to Valencia oranges and grapefruits.

Grapevines. Thrips (*Retithrips syriacus*) and a Bostrychid beetle (*Apate monacha*), caused severe damage. Downy mildew (*Plasmopara viticola*) was prevalent on the coastal plain.

Olives. The olive fly (*Dacus oleæ*) appeared from May through November. Damage was heavy in untreated groves. Fruit spot disease (*Macrophoma dalmatica*) was also very troublesome on olives punctured by the olive fly.

Carob. Powdery mildew (*Oidium ceratoniæ*) and leaf spot disease (*Cercospora* sp.) caused severe damage in regions of high humidity.

Deciduous fruits. Some varieties of plums were attacked by rust (*Puccinia pruni-spinosæ*). Powdery mildew (*Podosphæra leucotricha*) caused damage to apples in humid regions.

Vegetables and field crops. Leafhoppers were abundant during the spring and summer. An armyworm (*Prodenia litura*) appeared in very large numbers, causing heavy losses in peanuts, alfalfa, vegetables, fruit trees, grapevines and bananas under irrigation. Virus diseases were observed on cucurbits, pepper and also on flowers.

Potato root eelworm (*Heterodera rostochiensis*) was discovered on a 2 acre plot where potatoes were previously grown. A survey of the whole region, based on soil analysis, failed to show additional infestations, and it is hoped the pest may be eradicated.

Italy

Stazione di Frutticoltura e di Agrumicoltura
Acireale, Palermo

Presence of Tristeza Virus in Satsuma Mandarin Orange

The presence of the tristeza virus in Meyer lemon in the Mediterranean area has been proved by grafting tests. Meyer lemon is not grown commercially and trees in Algeria, Israel, Italy, Morocco which were found to carry the virus have been or are being destroyed.

More recently, similar grafting tests carried out at Acireale, have shown the tristeza virus to be present in Satsuma mandarin orange (*Citrus reticulata*) introduced into Italy in the last century directly from America and Japan. The Satsuma mandarin is not a commercial variety in Italy and it was grown only in certain collections in institutes and botanical gardens. All the Satsuma mandarin trees tested were found to carry the virus and all were destroyed.

In some other Mediterranean countries, particularly in North Africa, large plantations of Satsuma mandarin exist, and the talian finding therefore might be of considerable practical importance.

(The above information was received through the European and Mediterranean Plant Protection Organisation.)

Peru

CONSUELO BAZÁN DE SEGURA
Departamento de Fitopatología
Estacion Experimental Agricola de la Molina

Increased Prevalence of Nematode Root Disease of Cotton

In February 1956 ratooned cotton plants in many fields in the valleys of Cañete and Chincha were affected by a disease, causing green bolls to wither. The withered bolls remained on the plants. As reported by the Agricultural Experimental Station at Cañete and the Entomological Service of the Agricultural Association of Chincha, as much as 30 percent of the bolls were thus lost in the heavily affected fields and about 12 percent were lost in the least affected fields. However, during the early weeks of March when the cotton fields in that area were thoroughly examined, no further development of the disease was observed, especially in fields which were then irrigated.

In addition to a high percentage of the withered bolls, the affected plants were stunted and the leaves, especially those on the lower parts of the plant, were smaller and yellowish in appearance. In the underground parts of the affected plants, rootlets were almost completely lacking and injuries due to the attack of nematodes were evident, in many cases in association with *Thielaviopsis basicola*.

From the observations made, it is believed that the disease causing such heavy losses this year in the coastal region from Cañete and Ica was due to the attack of a nematode, probably *Meloidogyne incognita* var. *acrita*, in combination with *Thielaviopsis basicola*. As previously reported, [1] this nematode has been gaining importance in recent years, and the weather conditions during the early part of this year, especially the drought prevailing, apparently had accentuated the damage. Under conditions favorable to cotton growth, the regeneration of rootlets would have prevented the aerial parts of the plant from being severely affected. This may explain the recovery of the plants and the absence of newly withered bolls in the irrigated fields in early March when a change of temperature occurred.

Cotton varieties C. P. and S. N. A. were most susceptible to the disease. Under the conditions prevailing in the valley of Cañete, the variety L. M. W. 12-40 also showed high susceptibility. On the other hand, variety L. M. W. 395-42 performed satisfactorily in the heavily infested areas in the valley of Cañete.

In an area where monoculture is practised, the control of a soil-borne pathogene presents a difficult problem. The recommendations have been to eliminate as much as possible the ratoon crop and to cultivate the variety L. M. W. 395-42 in infested fields. The studies of the nematodes parasitic to cotton and the development of resistant varieties should be intensified.

[1] BAZÁN DE SEGURA, C. and F. PEDRO AGUILAR. 1954. Nematodes and root diseases of cotton in Peru. FAO Plant Prot. Bull. 3:20-21.

Plant Quarantine Announcements

Australia

Quarantine Proclamation No. 43 P of 13 March 1956, published in the *Commonwealth of Australia Gazette* No. 13, 22 March 1956, provides that:

(*a*) the importation of plants or parts of plants, other than seeds, of *Medicago sativa* (lucerne or alfalfa) is absolutely prohibited; and

(*b*) the importation of seeds of *Medicago sativa*, is prohibited, except in persuance of a permit issued by the Director of Quarantine and in accordance with the conditions and restrictions specified in the Quarantine (Plants) Regulations of 11 September 1935, as amended.

The total prohibition of the importation of lucerne plants and crowns is aimed at preventing the introduction of the virus causing lucerne dwarf and Pierce's disease of grapevine. The virus is not known to be seed-transmissible.

The restriction on the importation of lucerne seed is aimed at preventing the introduction of bacterial wilt caused by *Corynebacterium insidiosum* which has spread rapidly in the United States and Canada, and is also known to occur in Turkistan, Chile and Alaska. Although this disease may not be carried within the seed, its rapid dissemination can be explained only by its association with seed. Under the new Order, permission can be given for the importation of lucerne seed if adequate evidence is provided that the seed originates in a country where the disease is not present, provided that the country concerned possesses a recognized plant protection service.

France (Overseas Territories)

Order of 30 March 1956 regulating imports into certain territories under the jurisdiction of the Ministry of French Overseas Territories of products capable of transmitting and propagating hevea rubber diseases originating in Tropical America, published in the *Journal officiel de la République française* Vol. 88, No. 85, 9-10 April 1956, contains mainly the following provisions.

The importation into French West Africa, French Equatorial Africa, Togo, Cameroun, Madagascar and its dependencies, and Comoro Islands of any plants (living or dead, including parts of plants) and products capable of transmitting hevea rubber diseases of Tropical American origin, especially the South American leaf blight (*Dothidella ulei*), proceeding from any infested country, is generally prohibited. The infested countries refer to those situated in the parts of the continent of America, including adjacent islands, which are bound by the Tropic of Capricorn (latitude 23 ½° S) and the Tropic of Cancer (latitude 23 ½° N) and the meridians of longitude 30°W and 120°W, and includes the part of Mexico north of the Tropic of Cancer.

The importation of living plants of the genus *Hevea* from infested countries into the territories mentioned above is prohibited, but under exceptional conditions the prohibition may be derogated by the Minister of the French Overseas Territories to permit the introduction of seedlings, cuttings, fragments or scions (excepting seed) of *Hevea*. Such materials must be cleared upon arrival by a competent authority of the importing territory and held under quarantine for a specified period under the supervision of a specialist.

Dead plants of the genus *Hevea* and containers thereof from infested countries, must be sterilized in the country of origin in accordance with a method approved by the authority of the importing territory and each shipment must be accompanied by a certificate issued by a qualified authority of the country of origin stating the method of sterilization.

The importation of living plants of genera other than *Hevea*, their containers and packing materials, soil, manures, and composts from infested countries into the French Overseas Territories indicated is prohibited unless:

(*a*) they are accompanied by a phytosanitary certificate issued by an authority of the country of origin stating that they are free from all parasites, especially the South American leaf blight; and

(*b*) a declaration has been previously submitted to the plant protection service of the importing territory, indicating the country and locality of origin, the nature and approximate quantity, the method of sterilization applied before shipment, the name of carrier, the ports of departure and entry, the probable date of arrival, the destination and proposed uses, and any other indication useful for the determination of the sanitary conditions.

Netherlands New Guinea

Order of the Director of Agriculture and Fisheries, dated 27 April 1955, amends the Decree of 8 January 1953 (see *FAO Plant Prot. Bull.*

1 : 111. 1953) with regard to the importation of cacao and *Musa* spp. This new Order provides that the importation of living plant material of cacao and living plant material (excepting seed) of *Musa* spp. is permitted only if the shipment is accompanied by a certificate issued by an official of the Department of Agriculture, Animal Husbandry and Fisheries of the Territories of Papua and New Guinea, attesting that the plant material originates in the Territories of Papua and New Guinea.

Union of South Africa

A pamphlet entitled " Requirements for the importation of potatoes and seed potatoes " was published by the Department of Agriculture in 1956 in order to bring together information in this regard and to explicate the prescribed precautionary measures. The information summarized is mainly based upon Proclamation No. 286 of 1936 and Proclamation No. 186 of 1953. Further information with regard to restrictions and procedures and prescribed forms of the official certificate concerning wart disease and sworn statement of consignor required are included. Provision has been made for the remission of the import duty for consignments of potatoes which, because of their freedom from diseases and pests, are considered to be suitable for planting. The requirements for obtaining this concession are given in the pamphlet.

News and Notes

Ecuador Ratifies the International Plant Protection Convention

The Government of Ecuador, whose representative signed the International Plant Protection Convention on 12 March 1952, deposited the instrument of ratification with the Director-General of FAO on 3 May 1956. The number of countries contracting to the Convention, including both signatory and adhering members, is thus, at the time of writing, 34, namely: Argentina, Australia, Austria, Belgium, Cambodia, Canada, Ceylon, Chile, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Greece, Guatemala, India, Iraq, Ireland, Italy, Japan, Korea, Laos, Luxembourg, Netherlands, New Zealand, Norway, Pakistan, Republic of the Philippines, Portugal, Spain, Sweden, the Union of Soviet Socialist Republics, the United Kingdom and Yugoslavia.

FAO Meeting on Storage and Processing of Rice

The fourth session of the International Rice Commission of FAO held in Tokyo in 1954 recommended the establishment of a working group to study and evaluate the technics for rice storage and processing as applicable to the rice-growing areas in Asia and the Far East. The first meeting of this Working Group on Storage and Processing of Rice, the members of which consist of experts from 18 countries, will take place in Calcutta, India, 5-10 November 1956. Among items to be discussed at the meeting, the following will be of special interest to those concerned with plant protection.

1. Losses in stored rice.
2. The importance of preventive measures in the protection of stored rice from insect pests, rodents and fungi.
3. Recent developments in the control of insect pests and rodents infesting stored rice.

Based upon information supplied by the members of the Working Group, background papers on the above subjects will be circulated to provide bases for discussions.

Roma - Tip. del Senato del dott. Giovanni Bardi